

What is claimed is:

1. an electronic control unit comprising:

a first control circuit section containing a program memory, an operation processing RAM memory, a microprocessor, and a
5 first series-parallel converter; and

a second control circuit section containing a communication control circuit section at least for carrying out communication of monitoring and control signals, a data memory, and a second series-parallel converter; and

10 in which serial communication of monitoring and control signals is carried out mutually between said first and second control circuit sections via said first and second series-parallel converters;

wherein said first control circuit section includes regular
15 transmission means and irregular transmission means, and said second control circuit section includes regular report means and an unprocessed data table;

said regular transmission means acts as write setting means that regularly transmits a control output data or a constant
20 set data from said first control circuit section with respect to said second control circuit section, and executes a retransmission processing from the first control circuit section to the second control circuit section in the case of presence of any communication error in confirmation reply of
25 whether or not the second control circuit section has received said regular transmission data;

said regular report means acts as one-way input readout means which regularly reports a monitoring input data and status information from said second control circuit section to said
30 first control circuit section, whereby no confirmation reply

of whether or not the first control circuit section has received said regular report data is carried out;

said irregular transmission means acts as transmission means that is applicable when any error is present in a report 5 communication provided by said regular report means, and is also applied when required as to a readout request for a monitoring input data of a specified address from said first control circuit section to said second control circuit section, and a readout request for reading out and checking a write save 10 data having been written and set by said regular transmission means;

said irregular transmission means further acts as readout request means that makes a readout request again from the first control circuit section to the second control circuit section 15 in the case of presence of any communication error in a report reply of a monitoring input data of a specified address or a write save data, said report reply being carried out as a confirmation reply to the fact that said second control circuit section has received said irregular transmission data;

20 said unprocessed data table acts as a receiving-side command memory arranged so as to sequentially save a command data for executing a confirmation reply when said second control circuit section receives any transmission data from said first control circuit section, and to sequentially erase said saved data when 25 said second control circuit section transmits the confirmation reply data to said first control circuit section; and the transmission of a regular report data can be carried out while preventing upstream communication jam-up from said second control circuit section to said first control circuit section 30 with said unprocessed data table.

2. The electronic control unit according to claim 1, wherein
said first control circuit section comprises reply-waiting data
table and retransmission means;

5 said reply-waiting data table acts as a transmission-side
command memory arranged so as to sequentially save a transmission
command that said first control circuit section has transmitted
to said second control circuit section with regular transmission
means and irregular transmission means, and to sequentially
10 erase said saved command when receiving a confirmation reply
data or a report reply data from the second control circuit
section; and

 said retransmission means acts as means that operates when
there is any communication error in a confirmation reply or
15 a report reply to said regular transmission means or irregular
transmission means, or when a leading transmission command
having been stored in said transmission-side command memory
is not erased even after a predetermined time period has passed,
and transmits again a transmission data based on said error
20 transmission command; and a transmission command having been
transmitted again is deleted from and re-stored in said
transmission-side command memory, and a first-in first-out
processing is carried out.

25 3. The electronic control unit according to claim 1, wherein
said second control circuit section comprises readout request
setting means:

 said readout request setting means acts as means for making
the request for the readout of a selected data memory of a
30 specified address that is provided in said second control circuit

section by adding a readout request flag to a status information contained in said regular report means; and

said first control circuit section is arranged so as to operates when there is a communication error in said regular report data, or when said readout request is present, and to be capable of making a readout request for a regular report content or a selected data memory with said irregular transmission means.

10 4. The electronic control unit according to claim 1, wherein at least one of said regular transmission means or regular report means comprises division circulating means; and

15 said division circulating means acts as means that divides a large number of control output data intended to be regularly transmitted or a large number of monitoring input data intended to be regularly reported, and sequentially divides and transmits or sequentially divides and reports in a cycle corresponding to a required emergency degree, whereby a data amount to be transmitted or reported at a single communication is suppressed.

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5. The electronic control unit according to claim 1, wherein said first control circuit section comprises regular report permission means; and

25 said regular report permission means acts as means for storing a command data that is transmitted by said regular transmission means to a memory of a predetermined address provided in said second control circuit section, and acts to permit the second control circuit section to transmit said regular report.

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6. An electronic control unit comprising:

a first control circuit section containing a program memory, an operation processing RAM memory, a microprocessor, and a first series-parallel converter; and a second control circuit section containing a communication control circuit section at least for carrying out communication of monitoring and control signals, a data memory, and a second series-parallel converter; and

in which serial communication of monitoring and control signals is carried out mutually between said first and second control circuit sections via said first and second series-parallel converters;

wherein said first control circuit section includes regular transmission means and irregular transmission means, and said second control circuit section includes regular report means; said first and second control circuits section include first and second communication error determination means, first and second adding-subtracting means, and first and second error occurrence definition means respectively, and said first control circuit section includes retransmission means;

said regular transmission means acts as write setting means that regularly transmits a control output data or a constant set data from said first control circuit section to said second control circuit section, and executes retransmission processing from the first control circuit section to the second control circuit section in the case of presence of any communication error in confirmation reply of whether or not the second control circuit section has received said regular transmission data;

30 said regular report means acts as one-way input readout

means which regularly reports a monitoring input data and status information from said second control circuit section to said first control circuit section, whereby no confirmation reply of whether or not the first control circuit section has received
5 said regular report data is carried out;

said irregular transmission means acts as transmission means that is applicable when any error is present in a report communication provided by said regular report means, and is also applied when required as to a readout request for a
10 monitoring input data of a specified address from said first control circuit section to said second control circuit section, and a readout request for reading out and checking a write save data having been written and set by the mentioned regular transmission means;

15 said irregular transmission means acts as readout request means that makes a readout request again from the first control circuit section to the second control circuit section in the case of presence of any communication error in a report reply of a monitoring input data of a specified address or a write
20 save data, said report reply being carried out as a confirmation reply to the fact that said second control circuit section has received said irregular transmission data;

said first and second communication error determination means act as plural types of receiving error determination means
25 that determine presence of absence of any error regarding various regular and irregular communication packets that a control circuit section on the side where the mentioned determination means is provided has received from the other control circuit section, or that discriminate a state that any communication
30 packet to be received cannot be received;

said first and second adding-subtracting means act as operation means that adds or subtracts a second variation value when any of said plural types of receiving error determination means determines the presence of error, and subtracts or adds
5 a first variation value when all the receiving error determination means determine the absence of any error to perform an addition-subtraction compensation with respect to a current value memory so as to offset each other, and stops an addition-subtraction compensation with said first variation
10 value at a predetermined normal-side limit value when the determination of the absence of error continues;

 said first and second error occurrence definition means act as comparison means that generates first and second error detection signals when a current value of said
15 adding-subtracting means gets out of a scope of a predetermined abnormal-side limit value as a result of accumulation of said first and second variation values;

 said retransmission means is means, which operates when any error is present in a transmission data provided from said first
20 control circuit section to the mentioned second control circuit section, or when error is present in a confirmation reply data in response to said transmission data, and with which the first control circuit section transmits again a communication packet corresponding to the old transmission command, and adds or
25 subtracts a second variation value with respect said first adding-subtracting means; and

 said second variation value is set to a value smaller than a permitted accumulation value, being a difference between said abnormal-side limit value and normal-side limit value, and
30 stopping the operation, or initialization and restart of said

first or second control circuit section is carried out responsive to the occurrence of said error detection signal.

7. The electronic control unit according to claim 6, wherein
5 said first and second control circuit sections comprise first and second initialization means;

 said first initialization means acts as means that operates when said first error occurrence definition means generates an error detection signal, resets a current value of said first
10 adding-subtracting means at a predetermined initialization value at the start of operation, and initializes and restarts a communication control circuit section provided in said second control circuit section;

 said second initialization means acts as means that operates
15 when said second error occurrence definition means generates an error detection signal, resets a current value of said second adding-subtracting means at a predetermined initialization value at the start of operation, and initializes to restart or stop the operation of a microprocessor provided in said first
20 control circuit section; and

 an initialization value of the first and second adding-subtracting means to be reset by said first and second initialization means is a value close to said abnormal-side limit value from said normal-side limit value.

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8. The electronic control unit according to claim 6, wherein
 said first and second communication error determination means comprise at least one of bit information monitoring means and reply delay monitoring means or receiving interval monitoring
30 means;

5 said bit information monitoring means acts as bit error determination means for determining presence or absence of any lack or mix in bit information such as parity check or sum check relative to a serial data communicated between said first and second control circuit sections;

10 said reply delay monitoring means acts as reply response error determination means for making an error determination at the first control circuit section, being a source side when a reply data from said second control circuit section in response to any data, which said first control circuit section has transmitted, cannot be received even when a predetermined reply response time period has passed;

15 said receiving interval monitoring means acts as receiving interval error determination means for making an error determination when a receiving interval time period of the other-side control circuit section with respect to a regular transmission data that said first control circuit section transmits or a regular report data that said second control circuit section transmits exceeds a predetermined value; and

20 said adding-subtracting means performs an addition-subtraction compensation with a first variation value when none of said bit information monitoring means, reply delay monitoring means, and receiving interval monitoring means makes an error determination.

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9. The electronic control unit according to 8, wherein said second variation value, which said adding-subtracting means adds or subtracts when the determination of said bit information monitoring means is a communication error, is a value larger than said first variation value; and a variation value, which

said adding-subtracting means adds or subtracts when the determination of said reply delay monitoring means or receiving interval monitoring means is a communication error, is a third variation value, being a value different from said second 5 variation value; and further said third variation value is a value smaller than a permitted accumulation value, being a difference between said abnormal-side limit value and normal-side limit value.

10 10. The electronic control unit according to claim 8, wherein said first control circuit section comprises a reply-waiting data table;

 said reply-waiting data table acts as a transmission-side command memory arranged so as to sequentially save a transmission 15 command, which said first control circuit section has transmitted to said second control circuit section, and to erase said saved command when said first control circuit section has received a confirmation reply data from said second control circuit section; and

20 said reply delay monitoring means acts as reply error determination means for making an error determination when a save time period of a leading data remained in said transmission-side command memory exceeds a predetermined value, and a command determined as a reply error and a command having 25 a confirmation reply of any receiving failure are sequentially deleted from said transmission-side command memory, and stored anew in the transmission-side command memory at the time of being transmitted again.

30 11. The electronic control unit according to claims 8,

wherein said first control circuit section comprises a first set data memory; and

said first set data memory acts as a data memory in which stored is a part or all of various control constants such as
5 first variation value, second variation value, normal-side limit value, abnormal-side limit value, or initial value to be processed in said first adding-subtracting means; or a part or all of various control constants such as permitted values of a reply response time period or a receiving interval time
10 period to be used in said first communication error determination means; and

a part or all of said various control constants are transferred and written from a non-volatile program memory cooperating with said microprocessor.

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12. The electronic control unit according to claims 8, wherein said second control circuit section comprises a second set data memory; and

said second set data memory acts as a data memory in which
20 stored is a part or all of various control constants such as first variation value, second variation value, normal-side limit value, abnormal-side limit value, or initial value to be processed in said second adding-subtracting means; or a part or all of various control constants such as permitted value
25 of a receiving interval time period to be used in said second communication error determination means; and

a part or all of said various control constants are transmitted and written from a non-volatile program memory cooperating with said microprocessor via said first and second
30 series-parallel converters.

13. The electronic control unit according to claims 6, wherein said second control circuit section comprises current value report means:

5 said current value report means acts as means for adding a current value of said second adding-subtracting means to said status information, and regularly reporting a resulting information to said first control circuit section.

10 14. The electronic control unit according to claims 6, wherein said first control circuit section comprises a direct input/output signal interface circuit, and either said first or second control circuit section comprises a watchdog timer and error occurrence storage means;

15 said direct input/output signal interface circuit is bus-connected to said microprocessor;

 said microprocessor is arranged so as to generate an output signal in response to a direct input signal having been inputted via said direct input signal interface, an indirect input signal

20 having been received by serial communication from a second series-parallel converter provided in said second control circuit section, and a content of said program memory to drive an electrical load group, which is connected to said direct output signal interface circuit, and to transmit an indirect 25 output signal via said first and second series-parallel converters to the second control circuit section;

 said watchdog timer acts as a run-away monitoring timer circuit that monitors a watchdog clear signal, being a pulse train, which said microprocessor generates, and generates a 30 reset pulse signal when a pulse width of said watchdog clear

signal exceeds a predetermined value;

said error occurrence storage means acts as an error storage circuit that stores said first and second error detection signals or a reset pulse signal to bring annunciation means such as alarm, display, printing, and history save in operation when said error detection signals are generated, and when the reset pulse signal provided by said watchdog timer is generated; and

said microprocessor is initialized and restarted when said watchdog timer generates a reset pulse signal and when said second error detection signal is generated, and a communication control circuit section of said second control circuit section is initialized and restarted when said watchdog timer generates a reset pulse signal and when said first error detection signal is generated.

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15. The electronic control unit according to claim 14, wherein said second control circuit section comprises an auxiliary CPU, and said first control circuit section comprises run-away monitoring means with respect to said auxiliary CPU;

20 said auxiliary CPU acts as a microprocessor that is contained in said second control circuit section along with an auxiliary program memory cooperating with said auxiliary CPU, an operation processing auxiliary RAM memory, an indirect input/output signal interface circuit and a second series-parallel converter, transmits an indirect input signal associated with a signal having been inputted via said indirect input signal interface circuit to the first control circuit section via said first and second series-parallel converters, and drives an electrical load group that are connected to said indirect output signal 25 interface circuit with an output associated with an indirect

output signal having been received from said first control circuit section via said first and second series-parallel converters;

5 said run-away monitoring means acts as means for monitoring with said microprocessor a watchdog clear signal, being a pulse train that said auxiliary CPU generates, and generating a reset pulse signal when a pulse width of said watchdog clear signal exceeds a predetermined value; and

10 when said run-away monitoring means generates a reset pulse signal, when said watchdog timer generates a reset pulse signal and when said first error detection signal is generated, said auxiliary CPU is initialized and restarted, and said error storage circuit is arranged to store the occurrence of error.

15 16. The electronic control unit according to claim 14, wherein said error occurrence storage means is constituted of count storage circuit; and

20 said count storage circuit counts an OR output with respect to said first and second error detection signals and a reset pulse signal provided by the watchdog timer or the run-away monitoring means, and brings said annunciation means in operation when said count value reaches a predetermined value.

25 17. The electronic control unit according to claim 14, wherein at least one of said first and second control circuit sections comprises driving stop means and clear means;

30 said driving stop means acts as a gate circuit that operates when said error occurrence storage means stores an error occurrence to inhibit driving of specified electrical loads, being a part of said electrical load group; and

said clear means acts as means for initializing an error storage signal provided by said error occurrence storage means by manual operation such as turning on a power supply switch again.

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18. The electronic control unit according to claim 16, wherein at least one of said first and second control circuit sections comprises driving stop means and clear means;

10 said driving stop means acts as a gate circuit that operates when a count value of said count storage circuit is not less than a predetermined value to inhibit driving of specified electrical loads, being a part of said electrical load group; and

15 said clear means acts as means for initializing a current value of said count storage circuit by manual operation such as turning on a power supply switch again.